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MORE FOOD FOR THE SOIL

by
GWEN CROSS

FARMING SERIES

BOOK SIX

LONGMANS



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BOOK 6

MORE FOOD FOR THE SOIL

BY

GWEN CROSS

With illustrations by

Cyril Cowell

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FOREWORD

In Book 5 you were told how you can help your soil by growing and burying green manures and cover crops. In this book you go on to read about other things with which you can feed the soil. Part 1 tells about artificial manures, and Part 2 about the best manure of all—farm manure.

PART 1. ARTIFICIAL MANURES

CHAPTER 1

TWO KINDS OF ARTIFICIAL MANURES

THERE are two kinds of artificial manures—those made from factory waste and those found in the rocks of the earth's crust.

Manures made from factory waste

Many plant foods are now made from the blood and bones of animals and from parts of fish. These are waste materials from big factories where meat and fish are canned. The blood is dried and made into a powder, which contains much nitrogen and phosphorus. The bones are ground by machines into a powder, which contains much phosphorus. The waste parts of fish are also made into a powder which is rich in nitrogen and phosphorus.

Manures made from rocks

In the deserts of Peru and Chile in South America there are large quantities of nitrate of soda. It dissolves easily in water, but there is no rain in the desert to wash it away. It contains nitrogen and is a very good plant food.

Phosphorus and potash manures are also found in rocks. Natural or rock phosphates are produced in North Africa, Nigeria, Florida and the Pacific Islands of Nauru and Ocean Island.

Money has to be spent in making these manures from factory waste or in digging them from the rocks. Sometimes they have to be carried long distances by ship, rail

and lorry from the places where they are made to the places where they are used. The farmer has to buy them and they may be very dear in places far from where they are made.

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. Find on a map the places mentioned in this lesson.
3. Name the two kinds of artificial manure.
4. What plant foods does factory waste put into the soil?
5. What plant foods do manures dug from the rocks put into the soil?
6. Why are artificial manures sometimes dear to buy?

CHAPTER 2

ABOUT SOME ARTIFICIAL MANURES

BECAUSE they have different plant foods in them, artificial manures help the soil in different ways. Some contain nitrogen, some contain phosphates, some contain potash and others contain several plant foods.

Nitrogen-giving manures

These give up their nitrogen quickly, so they are often used for annual crops. All plants need nitrogen, and, if they do not get enough of it, they cannot use the phosphate and potash foods they require.

Here are the names of some nitrogen-giving artificial manures:

Nitrate of Soda. This is put on the top-soil. It helps a crop that is weak or sick, but it dissolves very easily in water and is quickly washed away by the rain. It can be used after lime.

Nitrate of Ammonia. This puts much nitrogen in the

soil, but it is very strong and only a little should be used at a time.

Sulphate of Ammonia. This is a very useful manure in the tropics, as it is not washed away by the rain as easily as nitrates are. It can be used after lime has been put on the soil.

Phosphate of Ammonia. This is often used, as it gives both nitrogen and phosphorus to the soil.

Dried Blood. This contains both nitrogen and phosphorus.

Phosphorus-giving manures

These manures, which are called phosphates, give up their plant foods slowly when they are put in the soil. We have to wait some time before the water in the soil has dissolved enough of them to help the plants. Superphosphate is the most useful of them. As the name shows, it contains much phosphate in a form which the plant can use, and it dissolves more easily than other phosphates.

Here are the names of some phosphorus-giving artificial manures:

Bone Meal. This is used on soils which are rich in humus, but which have very little lime in them. The bones are broken into small pieces and then ground into meal in the factories which make it.

Fish Meal. This is a very good manure, as it contains much phosphorus and gives much food to the plants.

Basic Slag. This is a factory waste and is cheap, but it may have to be broken up and made into a powder by the farmer himself, as it is often sold in big pieces. It dissolves slowly, and is better than superphosphate on a heavy clay soil.

Superphosphate. The best way to use this is to put it on the soil about three weeks after putting on lime. A

quarter of a ton of lime and then one and a half bags of superphosphate on an acre of land gives more help to the crops than three of four bags of superphosphate alone. The reason is that the lime works on the acids in the soil and changes them so that they cannot steal the superphosphate from the plants. If we do not put lime on the soil first, the plants do not get as much superphosphate as they should. If we use lime and superphosphate together, we lose superphosphate and also damage the soil.

Potash-giving manures

There is often enough potash in heavy (clay) soils, or in soils which have had wood ash put on them. But for soils which need it, chloride of potash and sulphate of potash are used as manures.

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. What plant food do nitrates give to the soil?
3. What plant food do phosphates give to the soil?
4. Name the phosphate manure which is most used.
5. Why should we never put lime and superphosphate on the soil at the same time?

CHAPTER 3

SOME WEIGHTS AND MEASURES

BEFORE we read in the next chapter how to put manures on the soil, we should remind ourselves of some weights and measures.

A square yard (sq. yd.) is a square of which each side is 1 yard in length.

An acre contains 4,840 sq. yds and is almost equal to a square of ground each side of which is 70 yards long.

Here is a table of weights:

16 ounces (oz.) = 1 pound (lb.)

112 lb. = 1 hundredweight (cwt.)

2240 lb. }
20 cwt. } = 1 ton

From this table we see that:

$\frac{1}{4}$ lb. = 4 oz.

$\frac{1}{2}$ lb. = 8 oz.

$\frac{1}{4}$ ton = 5 cwt. = 560 lb.

$\frac{1}{2}$ ton = 10 cwt. = 1120 lb.

Manure is often sold in bags weighing 1 cwt. each.

People who have carried out experiments with artificial manures usually tell us the best quantities to put on the soil in tons per acre. This is useful for people who have large farms and who perhaps have machines for putting on the manure. People with smaller pieces of land want to know how much they should put on a square yard of ground or round a single plant or seed. The next table shows what certain weights of manure per acre means per square yard:

1 ton per acre is about $\frac{1}{2}$ lb. or 8 oz. per sq. yd.

$\frac{1}{2}$ ton per acre is about $\frac{1}{4}$ lb. or 4 oz. per sq. yd.

$\frac{1}{4}$ ton (5 bags) per acre is about 2 oz. per sq. yd.

$2\frac{1}{2}$ bags per acre is about 1 oz. per sq. yd.

Everyone does not have scales with which to weigh small quantities of manure, but most people can get spoons. With these they can measure nearly the right weight. (Spoons used for measuring artificial manure should not be used for anything else.)

1 teaspoon (tsp.) of manure weighs about $\frac{1}{4}$ oz.

1 tablespoon (tblsp.) of manure weighs about 1 oz.



1 teaspoonful = $\frac{1}{4}$ oz.



1 tablespoonful = 1 oz.

Easily measured quantities of manure which may be used for different crops are:

<i>Manure</i>	<i>Crop</i>	<i>Amount per acre</i>	<i>Amount per sq. yd.</i>
Nitrates ...	Maize, rice	$\frac{1}{4}$ to 1 bag	$\frac{1}{12}$ oz. or $\frac{1}{3}$ tsp. to $\frac{1}{2}$ oz. or $1\frac{1}{2}$ tsp.
	Other	1 to 2 bags	$\frac{1}{3}$ oz. or 1 tsp. to $\frac{2}{3}$ oz. or $2\frac{1}{2}$ tsp.
Super- phosphate	Maize	1 to 2 bags	$\frac{1}{3}$ oz. or 1 tsp. to $\frac{2}{3}$ oz. or $2\frac{1}{2}$ tsp.
	Other	3 to 8 bags	1 oz. or 1 tblsp. to $2\frac{1}{2}$ oz. or $2\frac{1}{2}$ tblsp.
Potash ...	All	1 to 2 bags	$\frac{1}{3}$ oz. or 1 tsp. to $\frac{2}{3}$ oz. to $2\frac{1}{2}$ tsp.



Cabbage



Tomatoes



Lettuce

NITRATES

Cabbages, tomatoes and lettuces like much nitrogen.



Onion

Melon

Maize

POTASH and PHOSPHATES

Onions, melons and maize like much phosphorus and potash.

A good mixed manure is made with 1 part sulphate of ammonia, 3 parts superphosphate and $\frac{1}{2}$ part potash. Of this 4 oz. or 4 tblsp. should be given to 1 sq. yd.

CHAPTER 4

HOW TO USE ARTIFICIAL MANURES

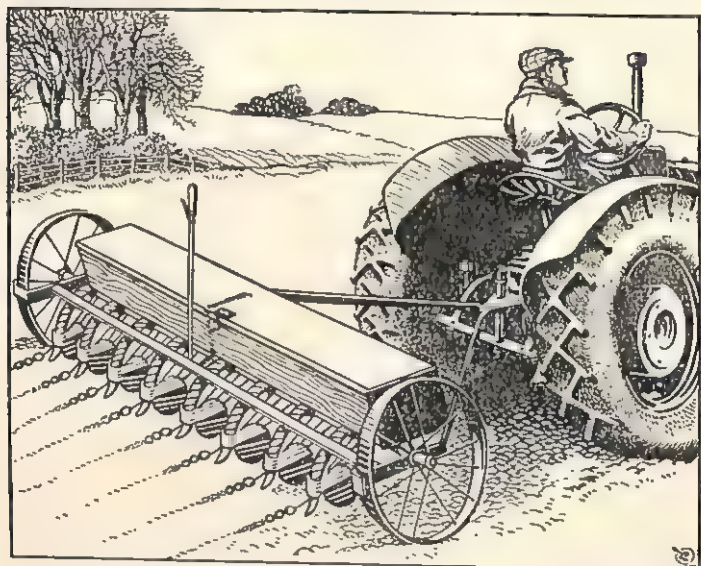
IN Chapter 2 we saw that different artificial manures help the soil in different ways, so you should not use artificial manure on your land until you know what help it needs. Before buying manure you should ask your Agricultural Officer which manure or what mixture will help it most. If you do not, you may waste your money by buying the wrong kind and may even make your soil worse instead of better.

Here are some rules for putting artificial manure on the soil:

1. Do not let the manure touch the roots, cuttings or seeds which you are planting.
2. Put the manure on with a spoon.
3. Put it round each plant or seed, or put it in lines between the lines of the crop.
4. For most plants put it on the top-soil.
5. For most seeds put one teaspoonful of the manure, scattered round the seed.
6. For root crops (sweet potatoes, yams, cassava, European potatoes), put one tablespoonful of manure at the bottom of the hole in which you are going to plant. Put a handful of soil over the manure, then plant in the hole.
7. If there is a big garden to be planted, you can mix



the manure with an equal quantity of *dry* soil, and then scatter the mixture in handfuls all over the garden. Rake it into the soil before planting the crop. (The manure is mixed with dry soil so that too much will not be put in one place.) Farmers who have many acres to plant use



machines for this work. One kind of machine plants the seeds in lines and puts a little manure with each seed. It then presses the seed gently down to the right depth and puts a little soil over it!

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. How much manure would you give each grain of maize when you plant it?
3. Where would you put this manure?
4. How much superphosphate would you put with each group of sweet potato cuttings?

5. Where would you put the manure?
6. If you were planting a big field of maize, how would you put the manure on the soil?

Note. If you use wood ash you can put it on with a spoon or scatter it, as is done with artificial manure. Do not let it touch the plants.

CHAPTER 5

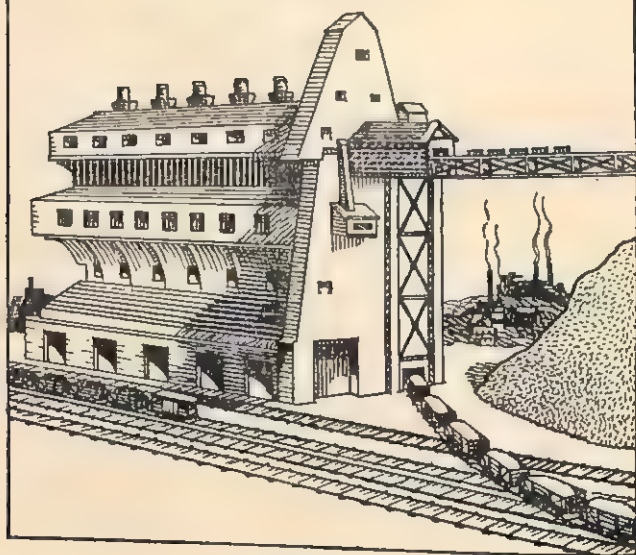
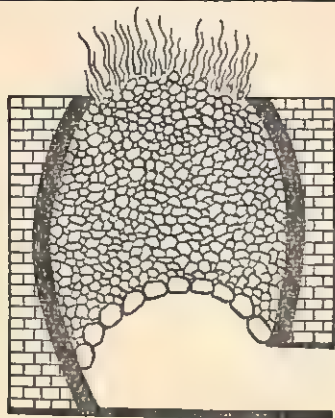
ABOUT LIME (BURNT LIME AND SLAKED LIME)

MANY years ago farmers learnt that lime helps the crops. They saw that some plants like lime and that some do not. We now know that lime is not a plant food, but that it helps the texture of the soil and that legumes and microbes need it. It kills things that damage the plants and it helps to prepare food in the soil for the plants to use.

Farmers often buy lime to use on their land, but if we live near the sea we can make our own lime from chalk or coral. There is lime in chalk, sea shells, coral and limestone rock. These change when they are made very hot for a long time. Water and a gas called carbon dioxide escape into the air and a white powder is left. This powder is called quick lime or burnt lime.

If we pour water on quick lime, it swells and becomes hot. It is then known as slaked lime, and it is not as strong as quick lime. If burnt lime is left in the air, it slowly takes in water from the air and changes to slaked lime. In the garden, dew and rain change burnt lime to slaked lime.

Farmers often put powdered chalk on the soil and dig it in. Acids in the soil slowly change the chalk into lime



BURNING LIME
Above: The old way.
Below: The new way.

and other things which contain lime and are good for the plants. Chalk does not harm the soil or the plants as lime might.

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. Is lime a plant food?
3. How does lime help the soil? Name two of the things it does.
4. How can we turn burnt lime into slaked lime?
5. Name two things from which, if we make them very hot, we can get lime.

CHAPTER 6

HOW TO USE LIME ON THE SOIL

1. Lime finds its way from the top-soil to the sub-soil, so it is better to give the soil a little lime often than to give it much only occasionally.

2. Scatter the lime all over the ground until the soil looks white on top. Then dig the lime in with a hoe or spade.

3. Do not put lime on the soil at the same time as artificial manure or farm manure. If it is put on the soil at the same time as superphosphate, it will steal the phosphate from the plants (see Chapter 2). If lime is put on the soil with nitrates, it changes them in such a way that the nitrogen is lost in the air and does not feed the crops.

4. If you want to use both lime and an artificial manure, you must put the lime on the soil three weeks before putting on the manure.

5. Different soils need different amounts of lime. Here

is a table showing how much to put on a square yard of different kinds of soil:

<i>Soil</i>		<i>Burnt Lime</i>	<i>Slaked Lime</i>	<i>Powdered Chalk</i>
Heavy loam	...	$\frac{1}{2}$ lb.	1 lb.	$1\frac{1}{2}$ lb.
Clay loam	...	1 lb.	2 lb.	$2\frac{1}{2}$ lb.
Sandy loam	...	$\frac{1}{4}$ to $\frac{1}{2}$ lb.	$\frac{1}{2}$ to $\frac{3}{4}$ lb.	$\frac{3}{4}$ to 1 lb.
Very sandy loam	...	$\frac{1}{4}$ lb.	$\frac{1}{2}$ lb.	$\frac{3}{4}$ lb.

6. Soils which have not enough lime in them may be acid. It is for this reason that we put on lime, which changes the acid so that too much is not left in the soil. Some plants, however, like an acid soil and others do not.

Sweet potatoes, tomatoes, cow peas, maize and millet like acid soil and we do not need to give them lime.

Beans, carrots, cucumbers, pumpkins, water melons and turnips like some acid in the soil, so we may have to put on a little lime to take away the extra acid.

Cabbages, cauliflowers and egg-plants like only a very little acid, so we may have to put more lime on the soil than for the others.

Some plants, like lettuces and onions, do not like any acid, so for them we may have to put much lime on the soil.

If we put too much lime on the soil, the first crops will be yellow and unhealthy. Some of the lime will, however, be used up in changing the acid, and the next crop will be green and healthy.

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. What does lime do to acids in the soil?
3. Why do clay soils need more lime than sandy soils?
4. Why do we put less burnt lime than slaked lime or chalk on the soil?
5. Name a plant that likes an acid soil, one that likes a little acid and one that does not like any acid at all.

CHAPTER 7

EXPERIMENTS WITH ARTIFICIAL MANURES

IN England there are farms where experiments with soils and crops are carried out. The Government helps with this work, giving money towards the expenses. Here is an account of one experiment which was begun many years ago.

The land of one of the farms was divided into three strips. The first strip was ploughed and wheat was sown. It was then left, and no more work has been done on it for over fifty years. The first year, when the wheat was sown, there was a fair crop, but there were also many weeds. The second year the soil was covered with weeds and bushes, and only a few wheat plants grew. They looked like wild wheat plants and each had only a few grains on the stalk. Now the land has gone completely wild and looks as if it had never been cultivated at all.

The second strip was ploughed and planted with wheat. The crop was weeded and there was a good harvest. Each year the strip has been ploughed, planted with wheat, weeded and the crop harvested. Each year there has been a crop of wheat, though year by year it has become a little less. Because the strip has been weeded, the weeds and bushes have not grown over it. Each year some food has remained in the soil to feed the plants of the next crop.

In the first year the third strip was weeded, manured, ploughed and planted with wheat. The crop was weeded and there was a very good harvest. Each year the soil has been manured with artificial and other manures before ploughing, and then kept clear of weeds. Each

year the crop has been as good as that of the first year, and forty bags of wheat have been harvested each time.

This experiment shows that, if the soil is properly cultivated and fed, it will keep on giving good crops.

In another experiment on a second farm, wheat was planted on four strips. This experiment has been going on for nearly a hundred years and during all this time wheat has been planted every year, and all but the first strip have been given humus manures as well as artificial manure.

The first strip has never had any manure put on it, and the plants are short and poor. The harvests are small and they get smaller every year.

The second strip gets 200 lb. of artificial manure each year. The plants are taller and stronger than those on the first strip and give better harvests.

The third strip gets 400 lb. of artificial manure, and the plants and harvests are better than those on the second strip.

The fourth strip is given 600 lb. of artificial manure each year. This strip has the tallest and strongest plants, and the best harvests of all.

This experiment shows that the soil which is best fed gives the best crops and the biggest harvests.

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. In the first experiment why did the first strip become completely wild?
3. Why was the manure put on the third strip before it was ploughed?
4. Is it always true to say that the more artificial manure you put on the soil the better the crops will be?

CHAPTER 8

HOW ARTIFICIAL MANURES HELPED AN AMERICAN STATE

IN Indiana, one of the North American States, there were many square miles of waste land, where no crops would grow. In this part of the country there were many shallow rivers which dried up in summer, leaving mud and dead plants in the river-beds. These dead plants and leaves turned into humus, which did not change to plant food quickly enough to feed the new plants.

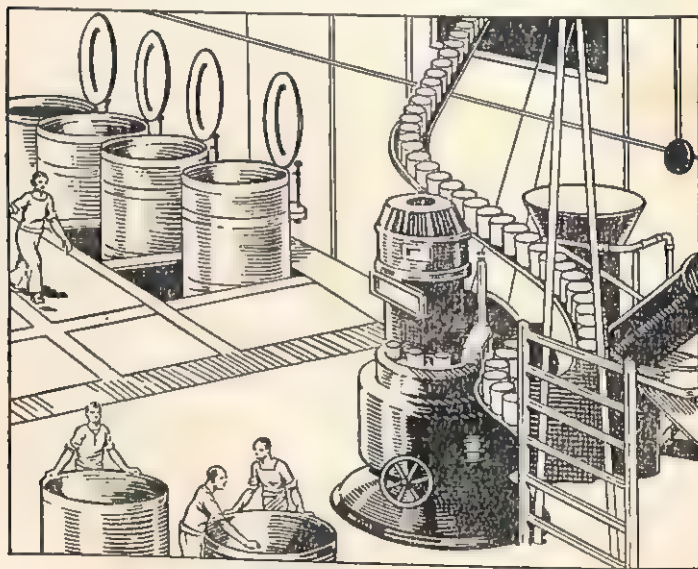
In 1936 three men were sent to Indiana to try to change the waste land into good agricultural land. They divided the district into strips and examined some of the soil from each strip. They found that all the soils had humus but not enough plant food. They also found what food each strip needed to make it able to grow good crops.

They bought as many different kinds of manures as they required to give each strip the plant foods it lacked. They dug in the amounts the soil needed and then they planted potatoes.

By 1940 these men, with the help of other workers, had changed six square miles of waste land into good agricultural land. They paid the wages of their helpers and also spent much money on buying manures to put on the soil. When the crops were harvested, they got more than three million bags of potatoes! These they sold and got enough money not only to cover the cost of the wages and the manures they had already bought, but also to buy more manure to put on more waste land.

So many potatoes are now grown on these reclaimed¹ lands in Indiana that great store houses have had to be built to receive them when they have been harvested. Big lorries, each carrying five tons of potatoes, make many journeys from the fields to the stores. In the stores, machines pack the potatoes into bags, each weighing 100 lb., until all the space is taken up. Some of the potatoes are sent to the markets, and large quantities of them are canned. The cans are then sent abroad, so that the potatoes feed thousands of people, not only in America, but in other countries also.

In Indiana there are still more than two hundred square miles of waste land which artificial manure can turn into good agricultural land. The land has humus, but plants



CANNING POTATOES

¹ Reclaimed land: waste land turned into agricultural land.

cannot grow on humus alone. Neither can they grow on artificial manures alone. When artificial manures are put into the soil with the humus so that the plants get plenty of food, then the soil becomes fertile and the harvests are good.

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. About what North American State is the story told?
3. What did the three men give to the soil to make it fertile?
4. How did they know what to put in the soil?
5. If you put artificial manure on soil which has very little humus, do you think you will get good crops?

CHAPTER 9

THE BEST MANURE OF ALL

ARTIFICIAL manures are now used by governments, missions, schools and farmers in many tropical countries, but they have to be bought and they are often dear. They can give good harvests if they are used by people who know what the soil needs and which manures will help it. If they are used by people who do not know these things, then both the soil and crops may have more harm than good done to them. If we drink the wrong kind of medicine, or the wrong amount of the right kind, we may make ourselves worse instead of better. We do not take two kinds of medicine at the same time unless we are told by the doctor or nurse to do so. In fact, if we are really ill, we do not take medicine at all until the doctor finds out what is wrong and tells us what to take.

Artificial manures are to the soil more like medicine than food; they do not feed the soil. They do not take the

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place of green manures and humus, and they help only when they are used on soil which has a good texture, and has humus in it. We should use them only after the soil has been examined by an Agricultural Officer and he has told us what to use, how much of it to use and how to put it on. When he has told us, we must do exactly as he has said. Without his advice we must never mix manures together or put them on the soil at the same time. Some should not even be stored together, for example nitrates and superphosphate.

In different parts of the world there are some foolish farmers who have been putting nothing but artificial manure on their soil. At first they got good crops, but soon they found that the crops began to get poorer. This was because the humus was being used up and not being replaced.

Perhaps you will think, "I have not enough money to buy artificial manures, and if I could get them I would not know how to use them. What can I do for my garden instead?" There is a manure which any farmer can make and which need cost him nothing in money. It cannot damage the soil, so he does not need to have his soil tested before he uses it. Yet it is the best manure in the world, as you will learn in the next part of this book.

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. For artificial manure to be of help to the soil, what must the soil have in it?
3. When farmers put only artificial manure on the soil, why does the soil get poorer?
4. What are the names of the three kinds of manure you have read about in Book 5 and the first part of this book?

PART 2. FARM MANURE

CHAPTER 10

THE FIRST TAME ANIMALS

LONG ago all the animals were wild. They lived in the bush, eating the grass and leaves and perhaps being eaten by other animals stronger and fiercer than themselves. The waste from the live animals, and the bodies of the dead animals, rotted on the soil. They mixed with the dead leaves under the trees and the dead grass on the plains to make manure, which helped the soil to grow more trees and grass.

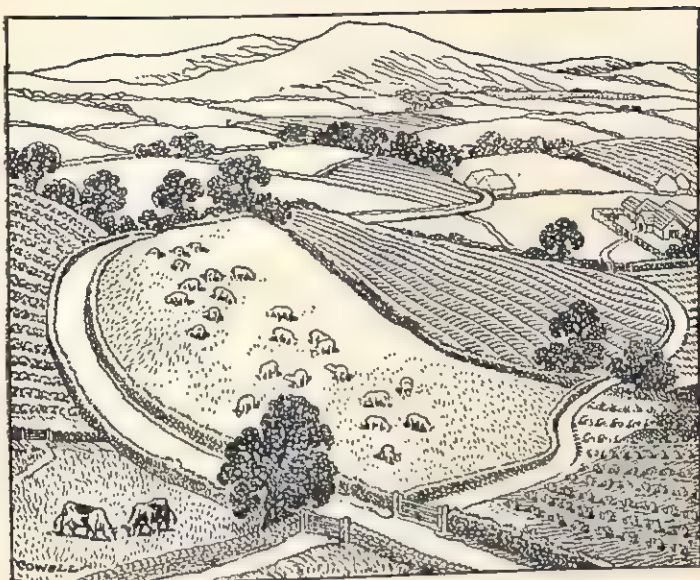
Then men tamed some of the animals, such as horses, cows, pigs and goats. At first these animals were tied to trees in and near the villages. The smaller animals, like pigs and goats, slept in the houses. Their waste fell on the soil round the houses, and in the houses too. There were bad smells and many flies which spread disease among the people.

The wiser people saw that it would be better to keep the animals out of the villages. They made fences or walls with trees and stones round some of their fields. Later other things were used to enclose the fields. In England farmers have planted hedges, which are lines of thick bushes growing close together with here and there a tree. These hedges are kept cut and trimmed so that they do not take up too much space and remain strong. In other countries stone walls or wire fences are used.

When farmers began to keep their animals in fields and not in and around the houses, the villages became cleaner. There were not so many smells, flies and diseases. The animal waste fell in the fields, and soon some of the farmers noticed something else.



DO NOT KEEP ANIMALS IN THE VILLAGE



FIELDS AND HEDGES IN ENGLAND

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. Name three animals which have been tamed by man.
3. Why did the wiser people want the animals to live in the fields away from the houses?
4. In which country do most of the fields have hedges round them? What is a hedge?
5. Name any other way you know of enclosing fields.

CHAPTER 11

HOW FARMERS USED THE ANIMAL WASTE

SOME of the farmers saw that on parts of their fields the grass was greener and grew more quickly than on other

parts. They soon saw that the better grass was where the animals slept at night. We can hardly doubt that they tried to find the reason for this, and at last decided that it was because the animal waste had fallen there. Perhaps they also saw that a field cultivated after the animals had grazed there produced better crops than the other fields, and that too helped them to find the reason.

Some of the farmers began to carry the animal waste to their gardens. They put it on the bare soil and left it to rot. Then they dug it in and planted a crop. No doubt some people laughed at them and others despised them, but they did not stop using the manure. They wanted good crops so they did not listen to the foolish people. The crops did grow tall and strong, and the wise farmers gathered big harvests from the soil which they had manured.

It is thousands of years since men first began to manure the soil with animal waste. It is one of the things the Chinese learned to use in their need to grow as big crops as possible. Now thousands of farmers all over the world collect or buy animal waste to enrich their soil.

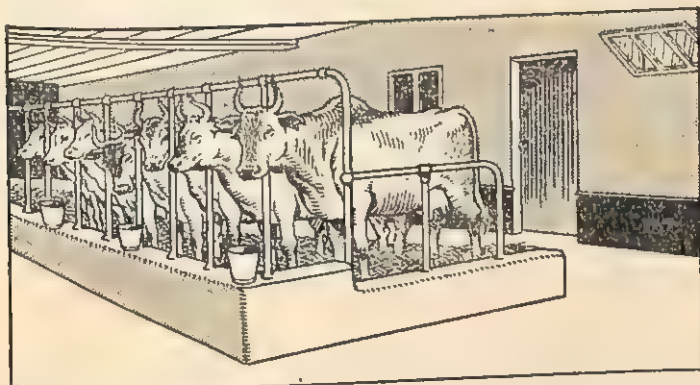
QUESTIONS

1. Write down the new words in this lesson and learn them.
2. What did the farmers notice about the fields the animals slept in?
3. What did they decide was the reason for the better grass?
4. What did the wise farmers do? What did the foolish people do?
5. In what country did the farmers use animal manure long ago?
6. What do wise farmers in many countries now do to help their soil?

CHAPTER 12

BETTER WAYS OF USING ANIMAL WASTE

WHEN animals live all the time in the fields, all their waste falls there and only helps the grass to grow. Some farmers have a special place for the animals to sleep at night. It may be only an enclosure¹ to keep off wild beasts, it may



be an open shed or it may be a properly built house. Some farmers also make beds of grass, weeds, stalks or straw on the floor for the animals to lie on.

At night the animal waste falls on the bedding and gets mixed with it. Then, when the animals go back to the fields in the day-time, the bedding and the waste are raked together and taken away. Sometimes this manure is taken straight to the garden and put on the soil to rot. Sometimes it is put in a heap in a shed and built up until there is a great pile of it. The manure is left to rot for several

¹ Enclosure: something enclosed, like a piece of ground surrounded by a fence.

months in the shed, then as the planting season comes near, it is taken out and put on the fields. When the fields are ploughed, the manure is buried in the soil. Already well-rotted, the plant rubbish and animal waste quickly turn to good humus and plant food.

At first farmers did not know why this manure helped their crops so much. Now they understand, and they know that it is better to keep the manure in a shed with a concrete floor than to throw it out on the garden. The roof of the shed keeps the water in the manure from being dried up by the sun and the concrete floor keeps it from soaking away into the ground. In this way the manure rots better and very little of the plant food is lost.

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. What is animal bedding?
3. What do farmers do with this bedding after the animals have slept on it?
4. Why is it better for manure to rot in a shed with a concrete floor than to rot outside in the open?

CHAPTER 13

WHAT ANIMAL WASTE CONTAINS

MOST birds and animals eat parts of plants. Cattle, horses, sheep, goats, pigs and fowls eat grass and the leaves, stems and roots of other plants. Their bodies use parts of the plants to help them to grow and keep strong. Lime and phosphorus from the plants are built into the bones; nitrogen goes to make muscles and blood. The animals do not build into their bodies all the food they eat. Some of it they do not use, and this passes through their bodies to fall on the ground as waste.

Part of the waste is solid, and is called dung. The liquid part of the waste is called urine. The dung still contains much nitrogen, phosphorus and potash, and the urine contains much nitrogen. Both dung and urine are good manures, and, when they are put on the soil, they return to it the foods taken from it by the plants, which the animals have eaten. The plant foods in urine are already dissolved in water, and so are soon ready for the plant to use. The plant foods in dung have to be changed so that they will dissolve in water. This change takes place when the dung rots.

When animal wastes rot in the soil they put into it humus and the three foods the plants need most. The nitrogen foods change quickly and are ready for the plants in a few days. The potash foods take a few weeks to be ready for the plants to use. The phosphorus foods change very slowly and may not be ready for a few months. So the phosphorus foods remain longest in the soil, while the nitrogen and potash foods are the soonest ready and the soonest used or washed away by the rain.

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. What food helps to build bones?
3. What food helps to make muscle?
4. What are the names of the two kinds of animal waste?
5. Which is the better manure?
6. Which plant food is ready first? Which is ready last?
7. Which food remains longest in the soil?

CHAPTER 14

MORE ABOUT ANIMAL WASTE

If animals feed on good grass or trees, their waste will make good manure. If the grass or trees grow on poor soil, then the waste from the animals will also be poor in plant foods.

Young, healthy animals use more of the food they eat to build their bodies than do sick or older animals. The young animals have to feed active, growing bodies; the older ones have made their bodies and do not run about so much. Manure made from the waste of young animals does not contain as much plant food as manure made from the waste of older animals.

Manure from sheep, goats and pigs is very good; from horses and cattle it is not so good. Manure from fowls and other birds is both dung and urine, and is very strong. It often has lime in it and no unchanged parts of plants. The nitrogen foods it contains change quickly into plant foods. It must be put quickly on the soil or the best food in it will be lost before the plants can use it.

Although there are differences in the manures made from the waste of animals of different kinds and ages, all farm manures are good and can help the soil. Nothing of this kind should be thrown away as useless; every bit of it should go back to the soil.

The waste parts of fish often thrown away by people who live near the sea or beside lakes are not animal waste in the sense in which the words are used above. All parts of fish, however, make good manure with much phosphorus in it. If, when we clean the fish, we bury all the waste in

the garden or in the compost heap (see Chapter 15), we shall be giving very good food to the soil.

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. Name three creatures whose waste could be used as manure in your village.
3. Which manure would be best—the manure of a pig a year old or that of a pig five years old?
4. What is the chief plant food in fish waste?

CHAPTER 15

COMPOST MANURE

BRITAIN has sent many of her best and cleverest men to help the people of other countries. British missionaries, teachers, doctors, nurses, agriculturists¹ have gone all over the world. They have set up colleges, schools, hospitals and farms in order to help the people to live healthier, happier and fuller lives.

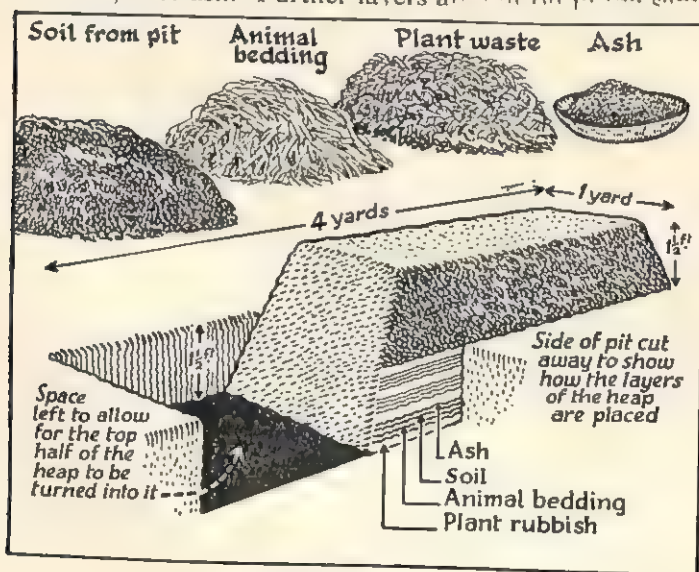
India is one of the countries which they have tried to help. In India there are nearly four hundred million people, by far the most of them living in small villages and growing their own food. As the number of people increased so did the need for more and more food. Every garden had to grow a crop each year, and the soil became poorer. In some places they tried to help the soil with artificial manures, but soon the crops began to get smaller again. Many of the people were nearly always hungry, and if the rains failed some even died of hunger or of disease against which they had no strength to fight.

An Englishman, Albert Howard, saw that in most places in India the soil lacked humus. He read many books,

¹ Agriculturist : one who knows about farming.

and in them he learned how, thousands of years ago, the Chinese farmers had kept their soil fertile while having to grow food for many millions of people. He saw that what the Chinese farmers had done was more wonderful than what the European and American farmers were doing with artificial manures. He made up his mind to show the people of India how to use all kinds of plant and animal waste to make humus and plant foods.

He made the manure in long narrow pits like those described in Book 4, Chapter 15, filling them with plant and animal waste, soil and ash. Any farmer can make this manure by first putting at the bottom of the pit a layer three inches deep of plant rubbish of any kind. On top of that is put a thin layer of animal bedding containing both dung and urine. Then comes a thin layer of soil and on this is put a thin layer of ash. Further layers are put on in the same



A COMPOST HEAP

order until the heap is three feet high from the bottom of the pit.

The heaps are kept damp, but not wet, and they are not pressed down firmly because the microbes need air. When the microbes are working properly, the waste rots and the heap gets hot. If the heap of waste is rotting well, it will be too hot for flies to live in it. If there are flies and a bad smell, we know that the microbes are not multiplying and that the heap is not rotting. We must try to find out what is wrong, remembering that the microbes in the heap need air and water as well as food and warmth.

The heap is turned and watered at the end of the first and second months. Some farmers leave a space three feet long at the end of the pit when they first make the heap. They turn the top half of the heap into this empty space, and then cover both halves with a layer of soil.

At the end of the third month the plant and animal wastes should have changed into soft, dark humus. There is much plant food in this humus, and, when it is put on the garden, the rain will dissolve the plant food so that the plants can use it. The parts which do not dissolve remain in the soil as humus. This kind of manure is the cheapest and best we can get.

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. How many people are there in India?
3. Look at Book 4, Chapter 15 and then write down the measurements of the pit mentioned there.
4. In what order are the waste, soil and ash put into the pit?
5. Why is the heap not pressed down firmly?
6. How do you know if the waste is rotting well?
7. What is done to the heap at the end of the first and second months?
8. If the waste does not rot well, what may be wrong?
9. After how many months should the manure be ready to spread on the garden?

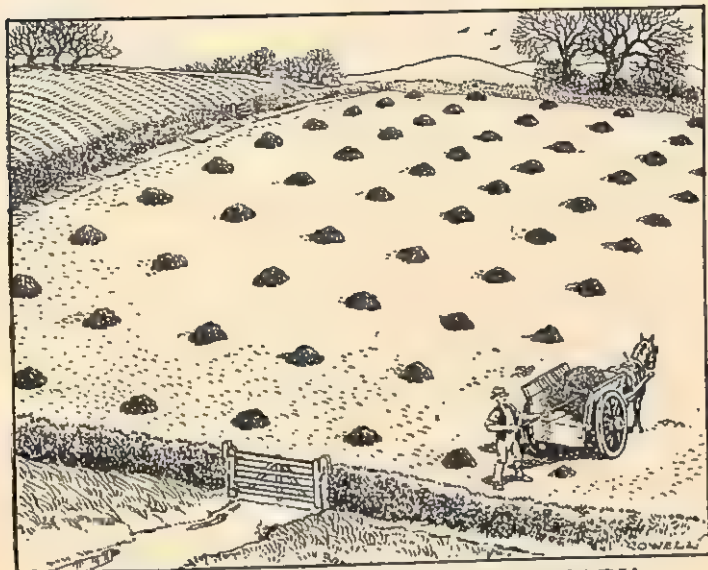
CHAPTER 16

COMPOST MANURE NOW USED IN MANY COUNTRIES

COMPOST manure was first made at Indore in India, and this way of making manure became known as the Indore Way. Now many farmers in England, Africa and other countries turn all their plant and animal waste into manure. Albert Howard, having been sent from England to help India, was able to help England and many other countries as well!

There are other ways of making compost manure besides letting the plant and animal waste rot in pits. In Lincolnshire in England, the farmers make the manure out in the fields. In this part of England peas for canning and large crops of potatoes are grown. At one time the soil began to get poor and the farmers saw that it lacked humus. After the peas had been harvested and the plants cut down, the farmers planted beans. They got the empty pea pods back from the canning factories and spread them in a thin layer on top of the soil. Then they put on a thin layer of animal manure.

As the pea pods and animal manure rotted on the fields, the beans, which had been planted as a green manure crop, grew up through the layers. About two months later, when the root nodules of the beans were at their best, the bean plants were ploughed into the soil together with the rotting manure. Pea pods, animal manure and bean plants all rotted in the soil together during the winter, and in the spring, when the new crop of potatoes was planted, there was plenty of good humus ready for them. The farmers got a very good crop, and, by continuing to take care of the soil, they are still getting good crops every year.



COMPOST MANURE BEING PUT READY
FOR SPREADING

Until a few years ago thousands of tons of waste was thrown away in every country but China. Now farmers in many countries see that all plant and animal waste should go back into the soil, which will then give strong, healthy plants. Only strong, healthy plants can give us good food to eat.

The best food comes from soil which has been manured with humus. The "best food" does not mean just "plenty of food". It means food that contains all the things which make strong, healthy men, women and children; and which make strong, healthy animals too, for we get much of our food from animals. Manure made from the rotted waste of plants and animals helps the soil to grow good food, and does it better than artificial manures. It can be made

by any farmer who keeps animals, and though it is cheap it is one of his greatest treasures.

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. Where was compost manure first made?
3. How did the farmers in Lincolnshire make compost manure?
4. What does the best food contain?
5. Why is compost manure one of the farmer's greatest treasures?

CHAPTER 17

WHAT THE FARMER CAN DO

IN these books we have read of many things which are helping people all over the world, and, if we have read carefully, we have begun to know something about the soil. We can now try to find out more about our own soil and how best we may help it. We may have to use new ways of farming, that is ways which are new to us but which have been tried and found good in other countries.

Perhaps some people will say, "Our soil is good, and we get enough to eat. Our fathers did it this way, and we do not like to change." Others may say, "Some people can do all these things, but we are too busy and we have neither the tools nor the money with which to buy them." The wise ones will say, "We cannot do everything at once, but we will make a start and do what we can."

Here are some of the things which farmers can do at once:

1. Begin collecting all plant rubbish, cooking rubbish and ash from the fires to make humus heaps.
2. If they have animals, collect grass and weeds for

bedding, and put the used bedding with plant waste, ash and soil to make compost manure.

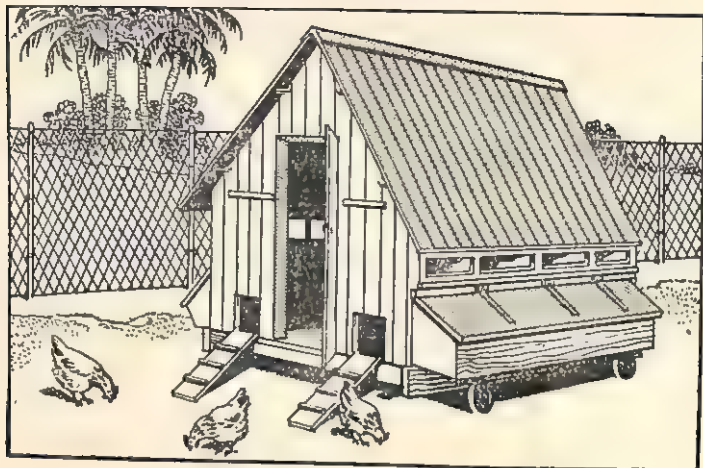
3. Grow green manure with seeds obtained from Agricultural Officers or missionaries. If the farmer can get only a few seeds, he should not use the first crop for green manure. He should let the plants seed, and collect and dry the seed carefully. He should go on doing this until he has enough seed to grow plants to use as a green manure. Each time he grows a green manure crop he must remember to allow some plants to bear seed so that he will have enough to plant another crop the following season.

Here are things which some farmers will be able to do now or later:

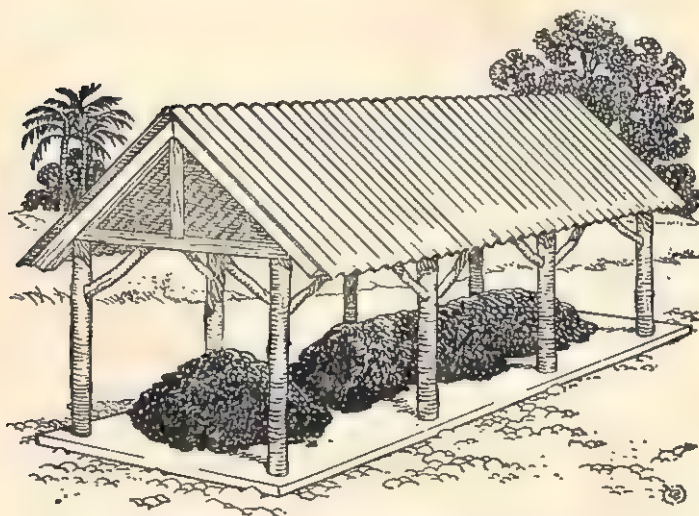
1. Fence in part of the land for the animals.
2. Build sheds for their animals and houses for their fowls to sleep in.
3. Make a roof to give shade for the dung heap.
4. Make a floor of flat stones or concrete for the dung shed.

The things which can be done by the farmer to help his soil are not the same in every country or even in every part of the same country. In this chapter we have mentioned only some, because the reasons for doing them have been explained in these books. There are others, which Agricultural Officers and their Assistants, missionaries and District Officers will be ready to tell you about. Ask them to help you and try to learn all you can from them.

We do not stop learning when we leave school; we keep on doing it all our lives, and only a very foolish person ever thinks that he has nothing more to learn. Do not scorn things which are new to you or laugh at the people who tell you about them. Always try to learn from others, whether they are your own people who have been away to other places or people sent by Government or the mis-



A WELL MADE HEN-HOUSE



A DUNG SHED WITH FLOOR AND IRON ROOF

sions to help you. That does not only apply to farming but to many other things such as preventing and curing illness, the care of mothers and babies, the care of animals, house building and so on. Above all, do not try to stop other people who are not afraid of new ways. There is an English proverb, "He laughs longest who laughs last", and, though you may have the first laugh, the man who tries the new way may have the last and longest laugh at your foolishness and fear.

QUESTIONS

1. Write down the new words in this lesson and learn them.
2. Name four kinds of manure which you have read about in Books 5 and 6.
3. How many of these could the people in your village use if they wanted to do so?
4. How would you make compost manure?
5. If someone gave you a few seeds of a green manure, what would you do with them?

Here are some of the words used in this book:

1. acre artificial spent factory waste equal
2. dung urine solid bedding liquid healthy
3. chalk towards agriculturist compost ground powder
4. nitrate phosphate reclaimed amount scatter lorry

Complete these sentences by using words from line 1:

1. Some —— manures are made by machines from ——.
2. Money is —— in digging manures from the ground
3. A square of land with sides 70 yards long is nearly —— to an ——.

Complete these sentences by using words from line 2:

4. —— is the —— part of animal waste; —— is the —— part.

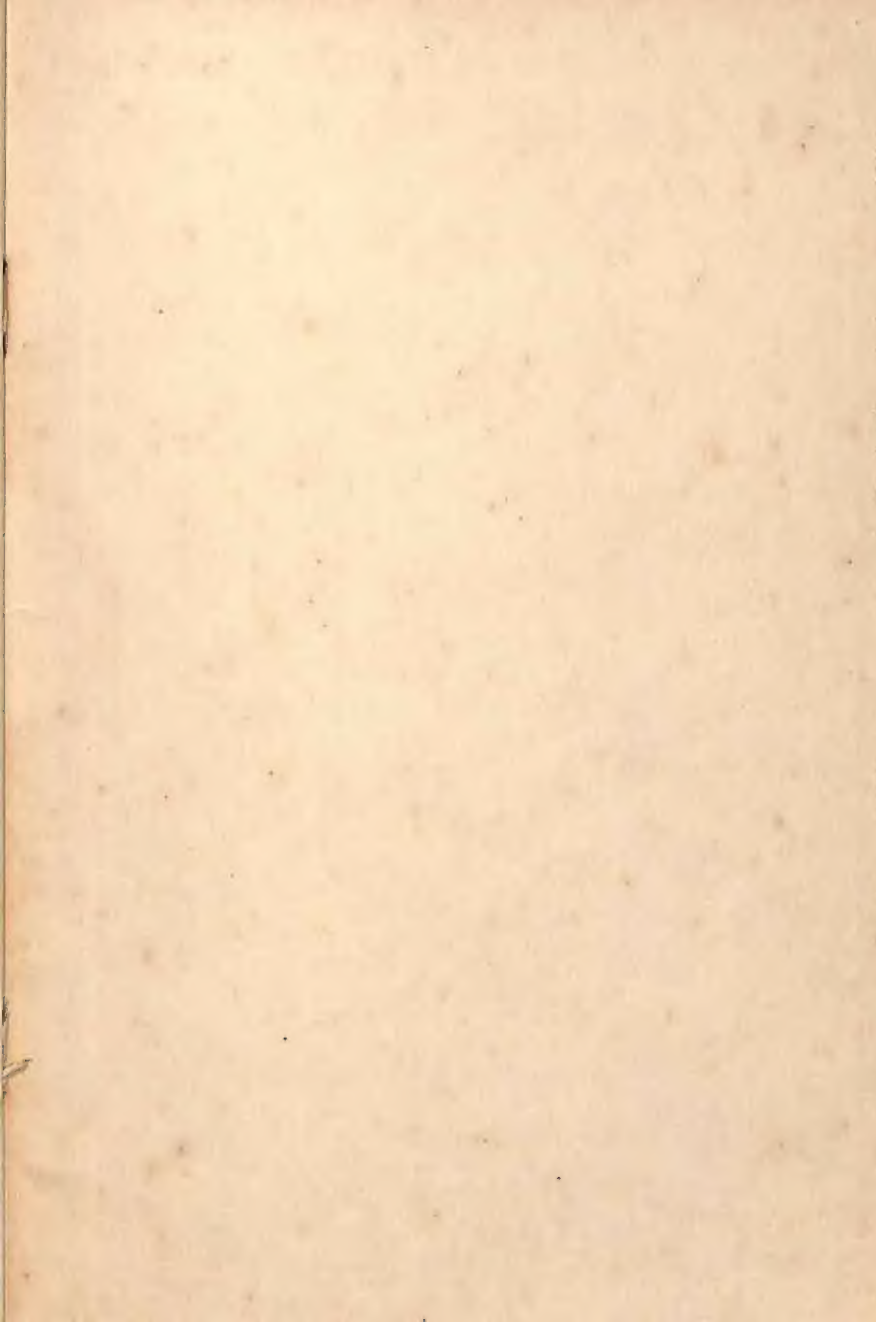
5. Farmers cut grass and weeds to make _____ for animals to sleep on at night.
6. Good food is food which makes men strong and _____

Complete these sentences with words from line 3.

7. A man who knows much about farming is called an _____
8. One kind of manure is made from bones which are _____ to a _____ by machines.
9. The acids in the soil change _____ to lime.
10. Government gives money _____ the cost of farming experiments in England.

Complete these sentences with words from line 4:

11. _____ of soda is found in South America. Rock _____ is found in North Africa.
12. We can _____ artificial manure mixed with dry soil on our gardens.
13. Land which men have made fertile is called _____ land.
14. A big _____ can carry a large _____ of rice at one time.



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3. The Farmer's Friends in the Soil
4. Better Ways of Farming
5. Feeding the Soil
6. More Food for the Soil
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